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NOTES ON AN ADDITION TO THE FISH FAUNA OF THE MOWRY SHALE (CRETACEOUS) OF WYOMING

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ABSTRACT

The incomplete remains of the skull and skeleton of a diminutive ray-finned fish from the Mowry Shale (Middle Cretaceous) near Cody, Park County, Wyoming, is described as a previously unrecognized addition to the Mowry fish fauna. The basic organization of morphologic characters suggests tentative assignment of the specimen to the leptolepiform genus *Clupavus*.

INTRODUCTION

During the course of the 1970 American Western States Heritage Tour, co-sponsored annually by the Cleveland Museum of Natural History and the Martha Holden Jennings Foundation of Cleveland, a brief examination was made of exposures of the Middle Cretaceous Mowry Shale in the vicinity of Cody, Wyoming. On that occasion one of the youthful participants of the tour, Dale Shisler of Bartlesville, Oklahoma, recovered a partial but articulated skeleton of a diminutive fish. The Mowry Formation and equivalent strata of Wyoming and adjacent Rocky Mountain states have long been known for their myriads of disassociated scales and other occasional elements of fishes. The principal contributor to the description of some of these has been T. D. A. Cockerell (1919). In view of widely recognized difficulties in reasonably accurate interpretation of macerated skeletal parts, the presently described specimen is indicative of the continuing incompleteness of information about the Mowry fauna and emphasizes the importance of more complete, associated, but undescribed materials from the formation also available in various of the nation's museums.

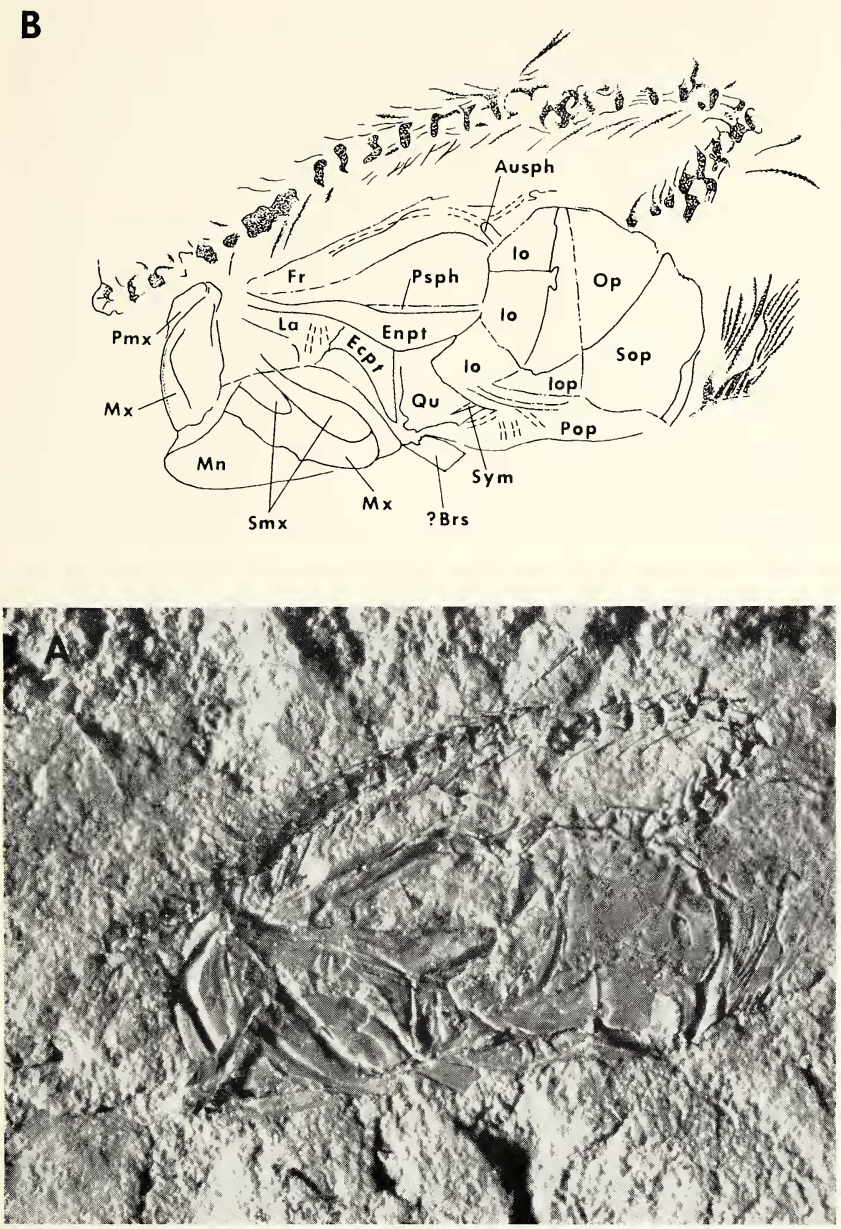
The specimen (Cleveland Museum of Natural History 11045) was encountered in Mowry outcrops immediately west of State Route 120, 1.7 miles south of the Cody Airport in Park County. Various stratigraphic sections of the formation in the Cody area and their lithologies have been described by Reeside and Cobban (1960). Displayed are the head, in left lateral aspect, with an attached series of 27 vertebrae, recurved acutely and forwardly over the skull roof. Little actual osseous tissue is preserved. However, the sharp and distinct impressions in the highly siliceous, fine-grained matrix of, in part, both internal and external surfaces of neurocranial and visceral elements of the skeleton permits observation of a significant number of basic morphological characteristics. These are here interpreted as denoting definite leptolepiform affinity and, in fact, within this order of halecostome fishes tentative reference of the specimen to the genus *Clupavus* Arambourg (1950) is suggested. Because of ignorance of caudal fin structure and other pertinent details, specific diagnosis of the fish is considered unwarranted, at this time.

Deep appreciation is expressed to Dale Shisler for his donation of this interesting specimen to the Cleveland Museum of Natural History. The photograph and drawings have been provided by the Cleveland Museum staff members Bruce Frumker and Barbara Gardiner, respectively.

DESCRIPTION

The total preserved length of the specimen is 28.6 mm of which the head occupies 10.6 mm. The posterodorsal border of the skull roof is not preserved at the midline, but this transverse plane, as reconstructed, is presumed to mark the deepest dimension of the head, with a measurement little more than two-thirds of the head length. Neural spines and ribs are delicate and short. These features combine to indicate a very slenderly fusiform body habit.

Fig. 1. *Clupavus* sp. (CMNH 11045) from the Middle Cretaceous Mowry Shale near Cody, Park County, Wyoming. (A) Photograph and (B) habit sketch of the specimen, as preserved. Reproduction approx. × 6.6. Explanation of abbreviations: Ausph, autosphenotic; ?Brs, branchiostegal; Ecpt, ectopterygoid; Enpt, entopterygoid; Fr, frontal; Io, infraorbital; Iop, interoperculum; La, lacrimal or preorbital; Mn, Mandible; Mx, Maxilla; Op, operculum; Pmx, premaxilla; Pop, preoperculum; Psph, parasphenoid; Qu, quadrate; Smx, supramaxilla; Sop, suboperculum; Sym, symplectic.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In lateral aspect, the skull would appear to have only a slight dorsal convexity. Preorbital and postorbital lengths of the neurocranium are short. The relatively large, ovate orbit has an axial length one-third that of the head from snout to posterior margin of the opercular apparatus. The quadratomandibular articulation is situated below the midorbital length and the mandibular symphysis is prominent.

Of the bones of the skull roof, the impression of the smooth superior surface of the right frontal is to be observed almost in its entirety. Indicated are extremely long and attenuated elements. The bone bears the supraorbital sensory canal, which in the postorbital region branches into a mesial, parietal extension and a lateral connection with the infraorbital and main supratemporal canals. The lateral margin of the skull roof in the otic region is obscured by remnants of adhering bone. These, however, undoubtedly represent portions of the dermosphenotic, autosphenotic and pterotic bones. In this area there is rather wide separation and no conjunction of the dorsal extension of the preopercular sensory canal with the supraorbital and infraorbital canals. Dorsolaterally the posterior edge of the pterotic is adjoined by an axially short and somewhat transversely elongated extrascapular. Visible portions of the dorsal margin of the parasphenoid exposed above the medial edge of the entopterygoid traverse the orbit horizontally.

The bones surrounding the mouth, as preserved, are distended upwardly and forwardly. The oral length of the premaxilla is scarcely one-fifth that of the maxilla, which has a constricted proximal part and a ventrally convex expanded distal portion, surmounted with anterior and posterior supramaxillae. The dentition as revealed by the internal impression of a maxilla is reduced to a narrow oral band of minute, clustered teeth. The oral margin of the mandible rises rapidly from the robust symphysis to a high coronoid process.

The infraorbital series consists presumably of five elements. The impressions of radiating sensory-canal grooves suggest a moderately expanded lachrymal or preorbital bone as does the preserved evidence of the outline of the posteroventral second infraorbital. The third and fourth infraorbitals are much shorter and there are no traces of suborbital elements.

A characteristic triangular expanse of a quadrate shows below the second infraorbital. The anterior margin of this bone lies ver-

tically in a transverse plane. An oblique and anteroventrally directed articular facet for the symplectic suggests a vertical or only slightly forward inclination of the hyomandibula. The anteromesial and posteroventral limbs of the ectopterygoid meet in a nearly 90° angle. Although anterior autopalatine and posterior metapterygoid sutures are obscured, the entopterygoid would appear to be expanded.

The opercular apparatus is complete. Ventral horizontal and dorsal vertical rami of the preoperculum are of disparate length and height. The length of the horizontal limb is somewhat less than half the length of the skull. A mesial flange along the forward edge of the preoperculum is indicated and suggests intimate internal support of the element by the hyomandibula and quadrate as well as the shift of origin of adductor mandibulae muscles which was acquired by the advanced halecostomes (Gardiner, 1967). The operculum is the largest of the complex with an oblique ventral margin meeting the vertical anterior border in an acute anteroventral angle. The posterior edge of the operculum is continued downward and forward by that of the subopercular in a broad sweeping arc. The interoperculum is horizontally elongated along with the ventral arm of the preoperculum which overlaps it widely. An impression of a bone beneath the anterior extremity of the preoperculum suggests that the branchiostegal rays were expanded and relatively few in number.

Of the 27 vertebrae preserved, the anterior 22 are considered abdominal and the remaining 5 caudal. The centra show little regional variation and are generally well ossified, with lengths slightly greater than their diameters. They are hourglass-shaped with very reduced notochordal perforations and bear laterally as many as three axial strengthening laminae. The proximal attachments of the neuropophyses with the centra are obscure but there appears to be a progressive gain in the robustness of these structures posteriorly. Epineural elements, as shown by delicate impressions across the neural spines, are definitely present in the midabdominal region. The proximal portions of the rib impressions recurve forwardly and lie parallel to the ventral borders of the vertebrae. Evidences of well defined parapophyses are absent.

From the point of low ventral attachment of the pectoral fin rays, the anteroventral limb of the cleithrum is short and constricted in comparison with the high and moderately expanded

dorsal ramus of the bone. The anterior margins of the two parts, meeting in a gentle forward concavity, are thickened into a mesially directed flange which forms the border of the opercular cleft. Little else of other girdle elements and of the radials can be ascertained. Pectoral fin rays number 7 in both the right and the left appendages, but may have totaled a few more. The rays of both fins are adpressed vertically along the posterior margin of the cleithrum. As impressed, the rays indicate long narrow fins, without evidence of axial jointing and with only the posterior rays dichotomizing.

DISCUSSION

The generic assignment of the presently described and incompletely revealed fish from the Mowry Shale may well be considered as extremely tenuous by many. It is tentatively offered, however, on the bases of general structures, proportions and relations of parts. Of fundamental significance in these connections are the attenuated frontals with the contained supraorbital sensory canals having parietal and infraorbital branches; absence of a confluence of the dorsal extension of the preopercular sensory canal with the supraorbital and infraorbital canals and consequent lack of a recessus lateralis (Greenwood and others, 1966) and similarities of mouthparts, the infraorbital elements, the hyopalatine complex and the opercular apparatus.

The genus *Clupavus* was defined by Arambourg (1950) for the reception of various small fishes from the Upper Jurassic of England and the Lower Cretaceous of Dalmatia, Jugoslavia and Gabon, which had originally been attributed to *Leptolepis*. Subsequently, *Clupavus* species have been recognized from the Cretaceous of Portugal (Ferreira, 1961); the Lower Cretaceous of the Congo (Casier, 1961); and the Upper Cretaceous (Cenomanian) of Morocco (Arambourg, 1954) and Lebanon (Patterson, 1967).

In the total brief literature concerning the genus there appears to be a general concurrence of opinion that *Clupavus* is a morphologic derivative of the halecostome fishes, through which narrow front the holostean-teleostean transition is thought most probably to have occurred. Within this framework *Clupavus* has been variously treated systematically: (1) together with the leptolepids within an advanced holostean level of organization (Greenwood

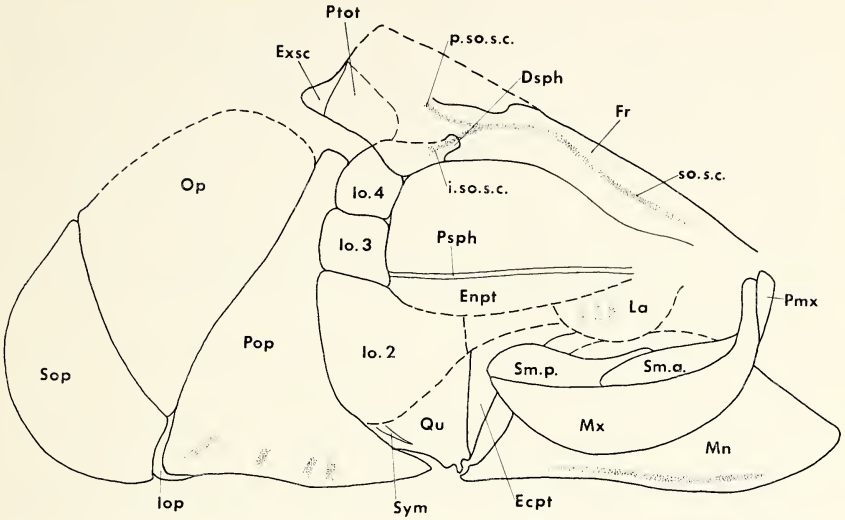

Fig. 2. Attempted reconstruction, in right lateral aspect, of the skull of the Mowry specimen (CMNH 11045) of *Clupavus*. Reproduction approx. × 10. Explanation of abbreviations: Dsph, dermosphenotic; Ecpt, ectopterygoid; Enpt, entopterygoid; Exsc, extrascapular; Fr, frontal; Iop, interoperculum; Io 2, 3, and 4, second, third and fourth infraorbitals; La, lacrimal or preorbital; Mn, mandible; Mx, maxilla; Op, operculum; Pmx, premaxilla; Pop, preoperculum; Psph, parasphenoid; Ptot, pterotic; Qu, quadrate; Sm. a., anterior supramaxilla; Sm. p., posterior supramaxilla; Sop, suboperculum; Sym, symplectic; i.so.s.c., infraorbital branch of supraorbital sensory canal; p.so.s.c., parietal branch of supraorbital sensory canal; so.s.c., supraorbital sensory canal.

and others, 1966; Andrews and others, 1967); (2) at a teleostean level of organization from which the leptolepids are excluded as of lower level (Arambourg, 1954; Bertin and Arambourg, 1958); and (3) at a teleostean level of organization in which the leptolepids are included (Arambourg, 1950; Casier, 1961; Danil'chenko, 1964; Romer, 1966 and Patterson, 1967). The two most recent and comprehensive classifications of fishes (Greenwood and others, 1966; Andrews and others, 1967) favor the first of these three alternatives.

Romer (1966, p. 354) reports another North American occurrence of the genus *Clupavus*. No formal reference to such a prior assignment has been found. It is, however, thought possibly to pertain to *Leptolepis nevadensis* David (1941) from the freshwater Newark Canyon Formation of the Lower Cretaceous (Nolan, 1962), since Miss David compared that species most favorably to the same suite of diminutive species on which Arambourg erected *Clupavus*.

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